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Memorial Issue

NOTES ON THE GENUS *EUDOLIUM* DALL, 1889

By

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Powell (1974) tentatively recorded the Indo-Pacific tonnid species *Eudolium pyriforme* (Sowerby,1914) from the Doubtless Bay area of New Zealand. In the meantime, several other specimens have been collected including a living 90.0mm long individual from Tokomaru reef, off Gisborne, 120 fathoms (*leg.* S. Mason), and the largest specimen on record, i.e. 106.0mm in length, came from Cable Bay, Mangonui (*leg.* M.Hamilton).

The synonymy, distribution and relationship of *Eudolium* with other tonnid genera are discussed below:

Family TONNIDAE

Genus *Eudolium* Dall, 1889

Eudolium Dall,1889, Bull.Mus.Comp.Zool.Harvard, 18:232 (subst.name for *Doliopsis* Monterosato,1872 — *non* Vogt,1852; *nec* Conrad,1865). Type species by monotypy (art.67i of ICZN) *Dolium crosseanum* Monterosato, 1869. Recent, Mediterranean and Atlantic.

Eudolium pyriforme (Sowerby,1914)

1914. *Dolium pyriforme* Sowerby,Ann.Mag.Nat.Hist.ser.8, 14:37,pl.2,fig.14 (Kii, Japan).

1961. *Eudolium pyriforme* (Sowerby),Garrard,J.Malac.Soc.Aust.No.5:17 (Broken Bay,N.S.W.,Australia); 1962 Kira,Shells west.Pacif.col. 1:59,pl.23,fig.5; 1967 Habe & Kosuge,Stand.book Jap.shells col. 3:66,pl.25,fig.12; 1971 Kuroda & Habe,Sea shells Sagami Bay, p.135,pl.37,fig.4; 1974 Wolfe, Hawaiian Shell News, 22(6):3,textfig. (Hawaiian Ids.); 1974 Powell,Rec. Auckland Inst.Mus.11:201 (New Zealand).

Type-locality: Kii, (Honshu), Japan.

Range: From Japan to the Hawaiian Islands, New Zealand and East Australia. Habitat: Subtidal, from 50 - 200 fathoms.

Recent species of *Eudolium* inhabit deeper water of the Mediterranean, the Atlantic and the Indo-Pacific, but have not yet been recorded from the west coast of the United States. *Eudolium* is well represented in European Tertiary deposits but fossil records from other areas are wanting. The New Zealand species "*Eudolium aoteanum* Beu,1970", from the Lower Miocene of Kaipara Harbour, New Zealand, is not an *Eudolium* and probably belongs to the cassid genus *Galeoocorys* Kuroda & Habe,1957, a genus which is closely related to *Cassidaria* Lamarck in shell and radular characters. The prominently nodulose sculpture, heavy wide-spaced spiral cords, distinct anal notch and parietal denticle, strongly plicate outer lip and stronger parietal callus shield of *aoteanum* are features which are not found in any of the living species of *Eudolium*.

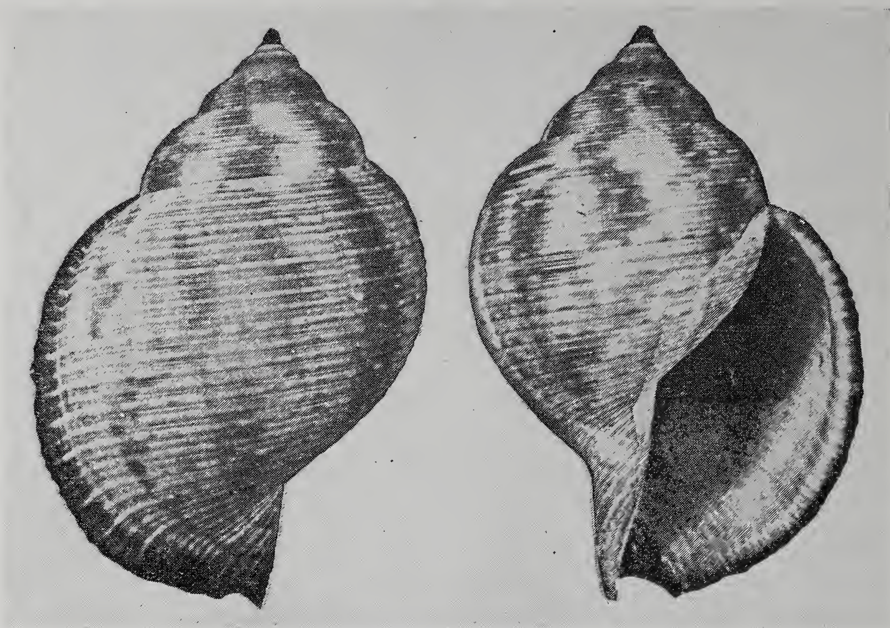


Fig. 1: *Eudolium pyriforme* (Sowerby). Tokomaru reef, off Gisborne, 120 fathoms. Length 90.0mm, width 60.0mm.

The known Recent species of *Eudolium* are:

E.crosseanum (Monterosato,1869) : Mediterranean to the East coast of the United States and South Africa.

E.crosseanum var.*solidior* Dautzenberg & Fischer,1906: Azores, E.Atlantic.

E.thompsoni McGinty,1955: Florida Keys to Gulf of Mexico.

E.pyriforme (Sowerby): Japan to Hawaii, New Zealand and E.Australia.

E.lineatum (Schepman,1909): Indonesia.

E.inflatum Kuroda & Habe,1952: Japan.

"Eudolium" aulacodes Tomlin, 1927, from South Africa, actually belongs to *Oocorys* Fischer,1883, while *"Morio"granulosa* Schepman,1909, from Indonesia, is a *Galeoocorys. Eudolium* is closely related to *Oocorys* but differs from the latter in having a thinner, lighter shell and a different radula. Adult individuals of *Eudolium* lack an operculum, the outer lip is narrow and reflexed and bears 30 or more small denticles and the parietal callus appears only as a thin wash rather than a well-defined callus-shield.

References

Beu, A. G.
1970 Descriptions of new species and notes on taxonomy of New Zealand Mollusca. *Trans.R.Soc.N.Z.,EarthSci.,*7(8):113-136,pls.1-5.

Powell, A. W. B.
1974 New Zealand Molluscan Systematics with descriptions of new species. Part 8. *Rec.Auckland Inst.Mus.* 11:197-207, textfigs.

THE PRESENT STATE OF KNOWLEDGE OF THE SYSTEMATICS OF NEW ZEALAND MOLLUSCA

by R. K. Dell, National Museum

In 1919 Charles Hedley in his obituary notice of Henry Suter, wrote, "Perhaps at no time did Suter quite realize the undiscovered residue of the fauna on which he worked. In his various reviews and revisions and supplements he wrote as if he had in hand if not all at least almost all the species of the area under consideration." I wonder how often various of Suter's successors have felt much the same as he appears to have believed, and how equally far from the truth we have all been. The production of Suter's Manual in 1913 was one of the great landmarks in the study of mollusca in New Zealand. Perhaps a little old-fashioned even when it was produced, it provided a magnificent baseline which was still unavailable in most other countries. There can be little doubt that the Manual stimulated work on molluscan systematics in New Zealand to a much greater degree than almost anywhere else in the world. Amateur collectors may well not realise that it is quite unique for a country of our size to have produced within fifty years a line of workers on mollusca of the status of A.W.B. Powell, J. Marwick, H.J. Finlay, C.R. Laws, C.A. Fleming, W.F. Ponder, A.G. Beu and F.M. Climo, quite apart from the many others who have not held professional posts, or who have studied biology, ecology, and anatomy rather than systematics.

The Plates to the Manual did not appear until 1915, and in the same year Iredale's Commentary was published. Suter himself, did not appreciate this criticism of his nomenclature, although Iredale's introduction was full of praise for the Manual in general. Critical it may have been but it was written in the true spirit of science, pointing out what was wrong and adding new information. But the Commentary was only the first of a series of works which were to advance our knowledge of systematics on two fronts.

Firstly collectors and scientists began with increasing tempo, a much more concentrated attempt to collect our molluscs more widely. More concentrated collecting and better geographical coverage meant that our shorelines were better explored, especially for smaller molluscs. Then using any method possible for them they extended their collecting out on to the Continental Shelf and in harbours covering depths from about 10 to 80 or so fathoms. The new species discovered began to be described in a steady stream.

Secondly scientists began to look much more closely at the classification of our molluscs. Before this, there had been a tendency to use "wide" genera for our New Zealand shells. The best documented areas in the world for molluscs were both sides of the North Atlantic and European seas, together with the copiously illustrated European Tertiary faunas. It was to these areas that New Zealand workers had looked to find genera which would fit New Zealand forms. Under Iredale's influence at first, but with H.J. Finlay leading the field later, critical comparisons made between these Northern Hemisphere genera and our southern species, showed that these Old World genera could no longer justifiably be used. As work continued on our Tertiary fossils, it became obvious that many of our New Zealand genera had long lineages through the Tertiary. From this it was argued that many of these genera had in fact evolved in the south and that a large proportion of our molluscan genera were probably endemic. If comparisons were necessary, one need hardly look further than Australia where many new forms had been described and figured by Hedley, and more were now being recorded by Iredale. At the same time scientists began to recognise that species varied from north to south and the use of subspecies and trinomial nomenclature began to be used for molluscs in this country.

The appearance of Finlay's large "Further Commentary on New Zealand Molluscan Systematics" in 1927 indicated the great advances in knowledge, but even more the great difference in outlook that had occurred in the short twelve years since the appearance of Suter's Manual. The "Further Commentary" must rank as the second landmark in this survey of our recent history. Many of my own generation of collectors and students of mollusca started with the only popular book on New Zealand shells available to us, C.E.R. Bucknill's "Sea Shells of New Zealand". Bucknill's introduction lead us back to Suter's Manual, still available in those days very cheaply from the Government Printer. The road to Finlay's "Further Commentary" was a harder one to find in those days, but when we met up with it, the enormous advance it represented was obvious.

But progress continued at an increasingly faster pace. Marwick's revisions of Tertiary and Recent species dealt with family groupings, Struthiolariidae, *Glycymeris,* Volutidae, Naticidae, Veneridae etc. and laid a firm basis for the systematics of many of our common species and demonstrated their Tertiary ancestry. Above all else, however, the work of A.W.B. Powell showed both the extent of the additional material which was being collected, and the amount of critical systematic evaluation required. His first scientific paper was published the year after the writer was born, and he is still actively working. It would be unkind, perhaps, to consider a person as a landmark, but undoubtedly several of his major works could be considered as such. And there could well be arguments whether the major one should be the long list of additions to the fauna which he has described, the discovery and description of the range of subspecies of both *Paryphanta* and *Placostylus,* his work on the Turridae, the indication of the wealth of small species living off the Three Kings, or his fathering of the Auckland Museum Conchology Club which in turn produced several generations of scientific workers on the mollusca, and untold numbers of serious amateurs. History will as usual be the final judge in such matters. But the writer believes that it is the production of "The Shellfish of New Zealand" in 1937 and its subsequent editions up to "Shells of New Zealand" in 1957 which supplies our third molluscan landmark since Suter. As someone who has personally and literally worn out several copies of each edition both as an amateur and as a professional, I may be biassed in believing that it was a godsend to us all. The complete checklist of New Zealand mollusca which it contained together with the key to all the complex literature since Suter's Manual, the useful general introductory chapters and the ever increasing number of illustrations provided, each filled the needs of a different user. In lieu of a new Manual, the serious student now had easy access to the maze of literature.

The pre-war period had been largely dominated by the Finlay-Marwick-Powell trio. After the war a new generation began serious studies of molluscan systematics. At that stage we might well have been excused had we considered that our fauna was fairly well known, and that all we needed was some concentrated work on classification, and some sensible revisions of a few difficult groups. After that was finished we could get on with other studies in distribution, biology and ecology. Just how wrong we would have been, events rapidly showed us.

The first really significant post war development came as one result of the growth of oceanography. Stimulated by the visits of overseas oceanographers to the 7th Pacific Science Congress in early 1949, the arrival of the survey ship HMNZS "Lochlan" towards the end of 1949, the visits of the British oceanographic vessel "Discovery II" in 1950/51 and of the Danish "Galathea" in 1951/52.

New Zealand marine scientists began to organise expeditions with the ships available to them. The first of these, the Chatham Island Expedition, working from Mr A.J. Black's 72 foot M.V. "Alert", was successful in working trawls and dredges down to depths of 330 fathoms. This expedition and subsequent work carried out from the "Alert" and other small ships particularly in Cook Strait and off Otago brought to light a completely new molluscan fauna off the edge of the Continental Shelf. The writer was fortunate in being able to accompany some of these expenditions, and wrote up the mollusca in a review of the archibenthal fauna. Subsequent work has shown that we still do not know the limits of this fauna and new material comes to light in almost every haul from deeper water.

The New Zealand Oceanographic Institute was formed in D.S.I.R. in 1954. and has carried out an immense extension of biological survey work on the Continental Shelf and beyond. Much of the molluscan material obtained has not yet been described or written up. Four universities have established marine biological stations, and two of these have sea-going research vessels attached to them. Deep water investigations have been carried out in Cook Strait by the Victoria University of Wellington, and off Otago by Portobello Marine Biological Station. The Fisheries Division of the Ministry of Agriculture and Fisheries also maintains its own research vessels which collect mollusca, amongst other animals, from many parts of New Zealand in the course of fisheries investigations.

The National Museum has organised expeditions to many parts of New Zealand using particularly Mr Black's "Alert" and her replacement, R.V. "Acheron". In the course of this work mollusca have been obtained from the Auckland Islands and the Antipodes in the south to the Kermadec Islands in the north, in depths down to 830 fathoms. The large collections obtained have still only partly been described. To give some idea of the wealth of material still to be described, five dredge hauls off the Three Kings Islands have produced somewhere in the order of 100 new species.

Together with this extension of collecting into deeper water there have been several other trends which have particularly affected work on systematics.

1. *Intensification of General Collecting*

Besides the work in deeper water over the last thirty years collecting in general has continued to expand. This is the area in which the amateur collector has played such an important part. Interest in shell collecting and the study of shells has spread throughout the country so that collectors can now be found in most settled areas. Every year their efforts bring to light new information on our molluscs. The list of new species and new records which have resulted from amateur collecting and interest would be long indeed. Even more importantly, perhaps, their observations indicate changes or additions to the fauna such as the recent invasions of *Theora lubrica* and *Limaria orientalis.* Nor are the amateurs any longer confined to the intertidal. Many collectors have carried out quite intensive dredging campaigns and have organised commercial fishermen to bring in regularly the interesting species from their catches. The use of diving gear particularly SCUBA has shown completely new facets to our fauna, especially from rocky areas where other methods of collecting prove impossible.

It would be unfair to try to name major contributors by name. Mention might be made of two collectors, neither of whom, because of physical disabilities were able to collect their own material, and yet managed to put together significant collections in fields in which no one had previously worked. The late Gordon Williams pioneered the extraction of shells, particularly small species from fish stomachs in the Bay of Plenty (his collection is now in the Auckland Museum). The late Mrs Elsie Smith working largely in isolation at Half Moon Bay worked at extracting small molluscs from shell sand samples brought in by fishermen from around Stewart Island and put together an extremely large collection from that rich area (her collection is in the National Museum). In many areas of science the part that amateurs can play in adding to knowledge has become severely restricted. In a country like New Zealand the amateur's role is certainly as important as ever, especially if the collector notes reasonable data with his specimens.

2. *Anatomical Investigation*

Careful investigation of the external features of the animal, study of radulae, gill structure and arrangement in bivalves, and of the genital apparatus especially in land snails has completely revised our ideas of the classification of major groups of our molluscs. The work of W.F. Ponder on rissoid-like forms and that of F.M. Climo on our smaller land snails are good examples.

3. *Study of Variation*

The much more extensive collections that now exist both within museums and elsewhere, and covering most of the New Zealand region has allowed much better evaluation of the extent of variation present in our molluscs. Some studies have already been published e.g. Ponder's work on *Buccinulum* and *Xymene* and Tucker Abbott's study of *Xenophalium.* But almost all the large families and genera of New Zealand molluscs require this kind of critical evaluation.

4. *Critical Examination of Generic Classification*

With greater ease of travel it has been possible for local workers to visit overseas museums and to study material related to New Zealand molluscs. Some restrictions have been eased regarding the loan of types and other material from overseas museums. In addition our collections of overseas molluscs held in New Zealand have increased markedly. Our New Zealand literature resources on the molluscs have been developed steadily since the war and the ease with which rare papers can now be copied means that we have access to literature which did not exist in New Zealand thirty years ago. As a result it is now possible to undertake many more critical studies of the supra-generic classification of our fauna. Powell's studies on the Turridae, Cernohorsky's on the Mitridae, Marwick's on the Turritellidae and Beu's on the Cymatiidae are examples of this type of work, which is placing our molluscan nomenclature on a much firmer basis and allowing critical comparisons with overseas faunas.

5. *Better Understanding of our Tertiary Mollusca*
Fleming's work on Tertiary faunas continued the earlier studies of Finlay, Marwick and Laws, and the younger generation of paleontologists including Beu and Maxwell have extensive studies in hand. This work on fossil mollusca throws a clearer light on our recent fauna and aids in understanding its development. New Zealand has been fortunate in having such a series of fossil beds covering in sequence all the main sections of the Tertiary. We are even more fortunate in that so many of our scientific workers have studied both fossil and living forms. Neither feature is usual in other parts of the world and the advantages to molluscan systematics have been quite outstanding.

All these different approaches have resulted in great gains to our knowledge of New Zealand mollusca since the publication of Suter's Manual. The tempo of advance seems to be ever increasing as new techniques and new attitudes and the results of more intensive training are all brought to bear. But finding one's way through the maze of literature produced has once again begun to prove difficult for amateur and professional alike. So many new species, so many rectifications of nomenclature, so many name changes and new records scattered through papers published in a wide range of journals, papers which if they can be brought together take up many feet of shelving! For some time now we have needed a synthesis and fortunately this synthesis will soon be available to us in the shape of Dr Powell's new Manual. Those of us who have seen parts of this work in the course of its production are confident that its appearance will stimulate even more effort to make our molluscan fauna better known. This time none of us, least of all its author, will feel that this synthesis will deal with our total fauna, nor that it will represent the last word in knowledge. The best qualified among us, after a very long working life on the group, has called a temporary halt, long enough to face a major consolidation and evaluation. Who can doubt that this will be a major landmark in progress.

What then may lie ahead? We have just seen the discovery of a subterranean fresh water molluscan fauna, collected largely by the Entomology Division of D.S.I.R. in the course of other investigations, and described by Dr Climo. We must surely expect that other new habitats will come to light. There are enormous deposits of subfossil land snails from cave deposits now ready for detailed study. The results of this work will undoubtedly change our ideas of land snail evolution here in New Zealand. The major trends in post war investigations will all undoubtedly continue. Perhaps the quite definite invasion of our northern waters by tropical and subtropical forms will increase, perhaps it will diminish and even vanish. The recording of this invasion and its ultimate fate will provide much of scientific interest in showing how our fauna has changed in the past, and this will assist us to understand similar happenings in our Tertiary.

One new technique alone will undoubtedly change our methods quite drastically and supply a new insight into molluscan relationships. Workers in this country as well as overseas are increasingly using the Scanning Electron Microscope (SEM) both as a research tool, and as a method of illustrating systematic papers. The basic technique is relatively simple once mastered.

the machine used extremely complicated and expensive. Several of the machines are being used by workers on mollusca in this country, including three microscopes in Wellington. In practice the specimen to be examined is coated in metal and then photographed as magnifications within the range of X20 to X10,000. Not only is the higher range of magnification much greater than is possible with a normal light microscope, but the depth of focus, even at low magnifications, is much greater than is possible with any other technique. Thus photographs of small shells a few millimetres across show much more detail than has been possible before. Under higher magnifications the minute sculpturing of the protoconch or interstitial ornamentation is revealed in detail which just cannot be seen under light microscopes, much less photographed. Structures like the radula can also be photographed to give a three dimensional effect which light microscopes cannot produce. The results gained from use of the SEM represent a great technical advance in the study of shells and of radulae. By showing details which cannot be seen in any other way these photographs allow critical comparisons between allied forms which were not previously possible, and reveal a number of new features which will obviously be useful as systematic characters.

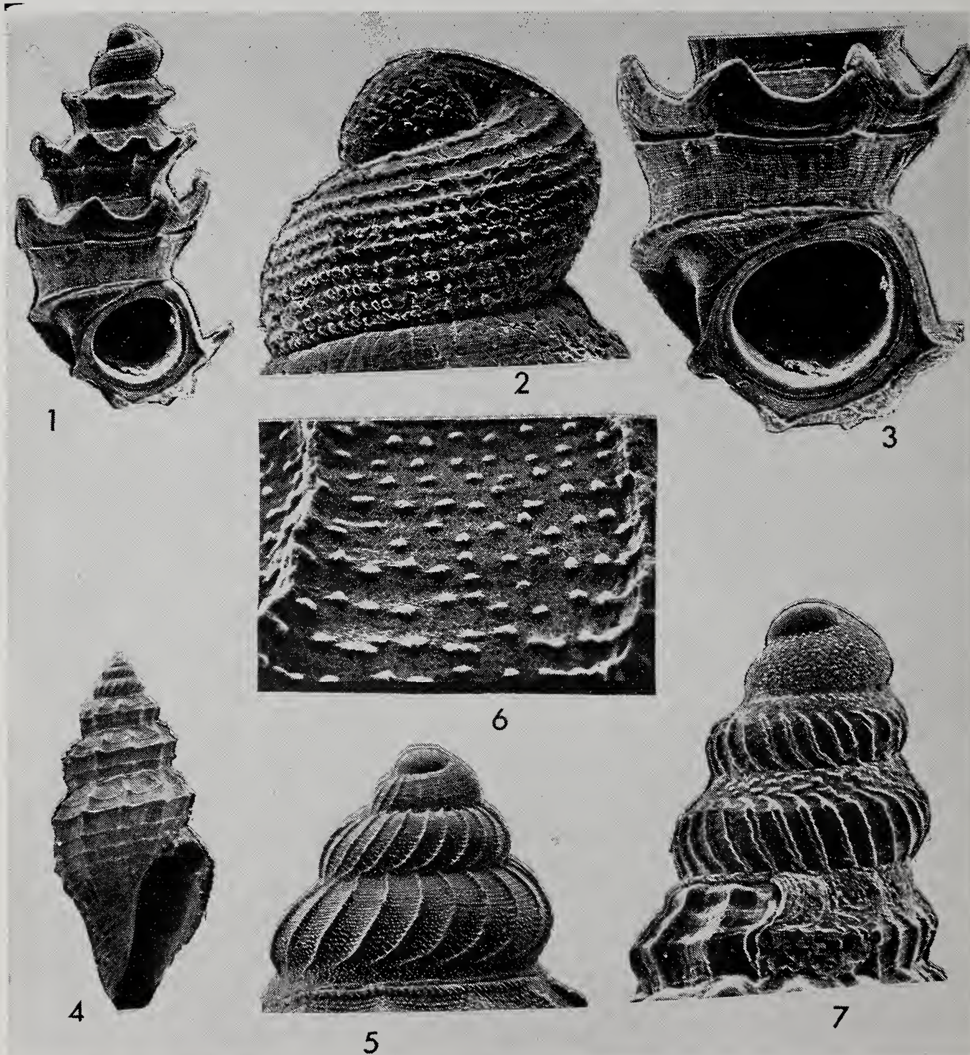
The use of the SEM is already beginning to revolutionise the practice of systematics and the method of illustrating scientific papers. The change is already dividing systematists into two distinct groups, those who have ready access to an SEM, and those who do not. The division will be most marked with people studying the smaller species although it will also arise in the study of radulae. Those scientists who cannot gain reasonably regular access to an SEM will be placed at a great disadvantage over the next decade. A comparable situation would arise at present if we were to deprive most workers on mollusca of both light microscopes and cameras and leave them using hand lenses alone. Because the cost of an SEM is so astronomically high the "have nots" will be placed in a hopeless and an unfair situation.

Increasing use of the SEM in a group like the mollusca must also mean eventual changes in systematic practice. Up to now the basic specimen used to determine the identity of each described species has been the holotype. This is a single specimen for each species which is normally carefully preserved in museum collections. While all modern systematists recognise that the holotype is only one example of the species and represents only that part of the variation to be expected in the species in life, it still remains the final arbiter of the identity of that species. Most descriptions of new species are accompanied by a figure, almost invariably of the holotype. The specimen which is figured by the SEM is coated in a thin layer of metal. The specimen may later be cleaned off although this is not an easy process and may damage the specimen. In practice it is usually retained as a gold-coated replica of the original specimen. Because the holotype should be retained in its original condition, scientists have not yet had the nerve to photograph the holotype under the SEM. Thus systematists who use SEM photographs to illustrate their new species may well have to also publish a photograph or figure of the holotype made by traditional means as well as an SEM photograph of a paratype. The difficulty may still arise if the holotype and figured paratype prove to belong to different species (it has happened often enough in the past). On the other hand SEM photographs are so perfect that the need to refer back to the holotype will almost disappear.

An additional problem which will arise will concern the identification of other specimens if the original description is illustrated with an SEM specimens if the original description is illustrated with an SEM photograph alone. The generic placing of some species may well depend upon details (of the protoconch for example) which are just not visible under the light microscope. It would be extremely tedious and impracticable if all specimens which need to be identified had to be coated and photographed under an SEM. Obviously if scientists use details visible only under the SEM for classification, they must also try to give us other diagnostic characters which we can all see under a light microscope.

It will undobtedly be necessary to draw up new ground rules for systematic work if this new taxonomic tool is to be properly used. Many of the difficulties would become less pressing when Electron Scanning Microscopes become simpler and therefore cheaper, and so more readily available.

Some examples of the results obtained by Dr. Climo and Mr Marshall of the National Museum using an SEM at Victoria University in Wellington are given here to show the kind of results that are possible. Even with the difficulties that must arise, one can only conclude that the SEM will open new windows on our study of molluscan systematics.



Figs. 1,2,3. *Promerelina coronata* Powell, Fig. 2, details of protoconch, Fig.3, details of aperture.

Figs. 4,5,6. *Heterocithara mediocris* Odhner, Fig. 5, protoconch, Fig.6, details of sculpture on part of protoconch.

Fig. 7 "Cerithiopsid" protoconch.

All photographs by B. A. Marshall.

THE OCCURRENCE OF *THEORA* (*ENDOPLEURA*) *LUBRICA* GOULD, 1861 (MOLLUSCA: BIVALVIA: SEMELIDAE) IN NEW ZEALAND

By F.M. Climo

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ABSTRACT

The arrival and distribution of *Theora lubrica* Gould, 1861 in New Zealand is discussed. The type of *Theora fragilis* (A. Adams, 1855) is illustrated.

INTRODUCTION

Theora (Endopleura) lubrica Gould was first recorded from New Zealand by Gardner & Gardner (1973) as *"Theora"*. It was recorded from a number of places in Auckland Harbour in 1972. Populations in this harbour appear to fluctuate markedly in numbers, with no specimens occurring in 1973 at sites where they were abundant a year previously (*loc. cit.*).

On November 27, 1971, National Museum biologists dredged a bottom sample from 4-6 m in Orakawa Bay, Bay of Islands, which contained many live specimens of *Theora lubrica* (Fig. 1). These would appear to be the earliest collected specimens in New Zealand. Early in 1972 Mr C. Willan found the species in sticky mud at Tutukaka, Northland (Powell, 1974). Powell introduced the species formally into the New Zealand literature in 1974.

In February, 1974, *T. lubrica* was collected from 12 m in thick black mud, Owhanga Bay, Whangaroa Harbour, Northland on the 'R.V. "Acheron" National Museum Northland Expedition.' On August 30, 1975, live specimens of *Theora lubrica* were dredged in abundance by R.V. "Acheron" from the following two Marlborough Sounds localities: National Museum Biological Station B.S.430: between Garden Bay and Deep Bay, Admiralty Bay, Pelorus Sound, in 48-50 m; B.S.431: Orchard Bay, Pelorus Sound, in 34 m.

In August 1973 I examined species of *Theora* in the Australian Museum, Sydney, and observations made then are relevant to a reinterpretation of the origin and distribution of *T. lubrica* in New Zealand.

SYSTEMATICS

Family SEMELIDAE

Genus: *Theora* H. & A. Adams, 1843

Type species (S.D.; Stoliczka, 1871) *Neaera lata* Hinds, 1843

Subgenus: *Endopleura* A. Adams, 1864

Type species (monotypy; A. Adams, 1864) *Theora lubrica* Gould, 1861

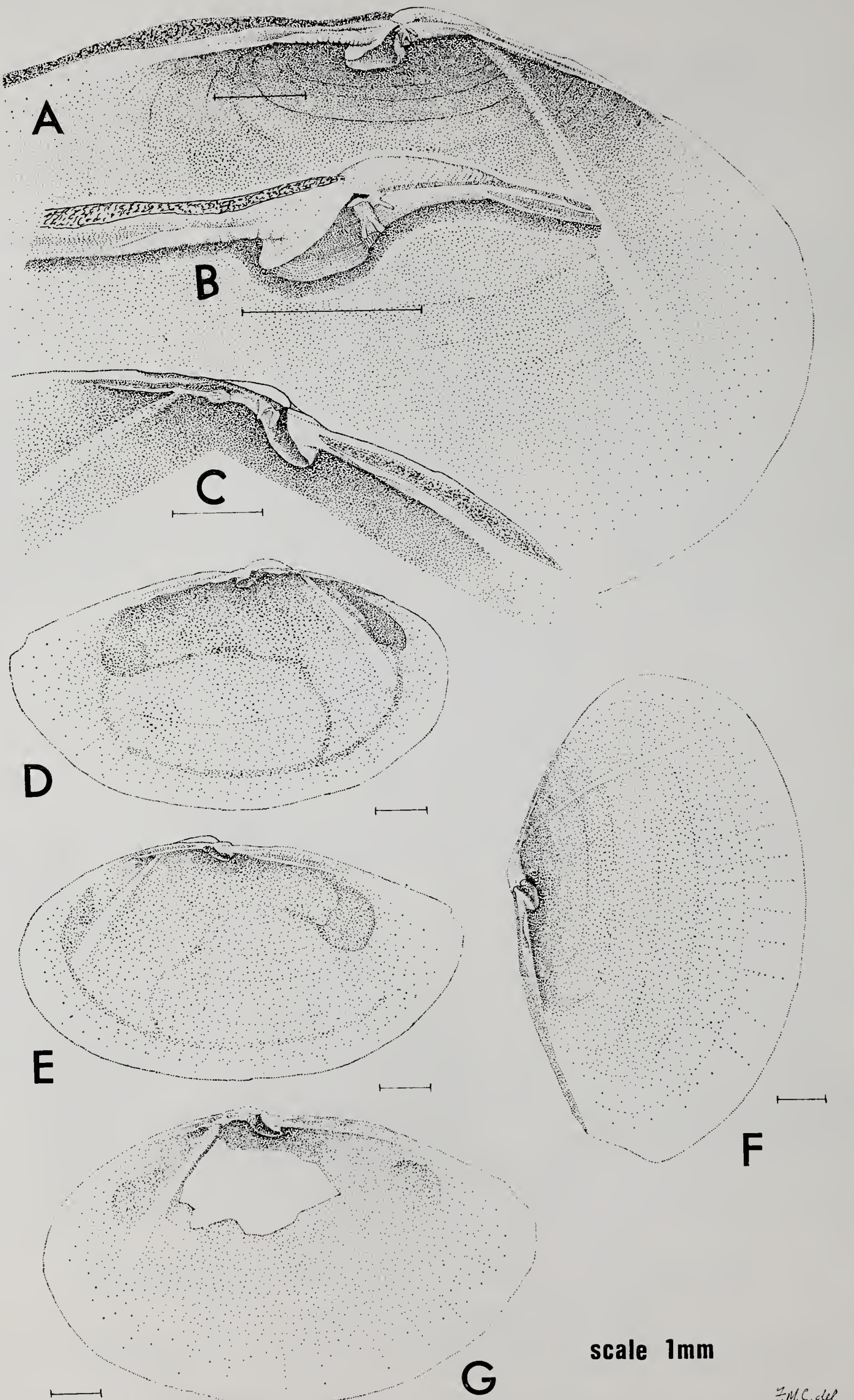

Fig. 1 *Theora (Endopleura) lubrica* Gould Left and right valves and hinge details; Orakawa Bay, Bay of Islands.

Subgenus *Endopleura* was defined: "Shell pellucid, gaping at both sides. Hinge with a bifid primary tooth in front of the oblique cartilage pit. Valves with an internal rib extending from the beaks obliquely towards the anterior side" (Adams, 1864). It is the internal rib, or chondrophore, which distinguishes *Endopleura* from *Theora* s.s. ; the nominate subgenus is otherwise identical conchologically.

Theora (*Endopleura*) *lubrica* Gould, 1861

Fig. 1

1861 *Theora lubrica* Gould, *Proc. Bost. Soc. Nat. Hist.* 8:24
1974 *Theora* (*Endopleura*) *lubrica.*—Seapy, *The Veliger* 16(4):385
1974 *Theora* (Endopleura) *lubrica.*—Powell, *Rec. Auck. Inst. Mus.* 11:203

Diagnosis as for subgenus. Fragile, semitransparent shell reaching an adult size of between 10 and 17 mm, depending upon locality; usually 10-12 mm. Shell shape resembles that of the protobranch, *Yoldia.* A markedly gregarious species.

Material examined. Holotype and paratype *Neaera fragilis* A. Adams, 1855 (British Museum, Natural History); specimens from New Zealand localities mentioned in introduction; 9 m, Botany Bay, N.S.W., Australia — Aust. Mus. Reg. No. 066613 (*lubrica*); Awaji, Japan —Aust. Mus. Reg. No. 040320 (*lubrica*). The holotype of *Theora lubrica* is figured in Johnson (1964).
Remarks. Specimens of *Theora* from Botany Bay, N.S.W., Australia, labelled as *fragilis* in the Australian Museum Collection were indistinguishable from specimens labelled as *lubrica* from Japan. Since there was a possibility that

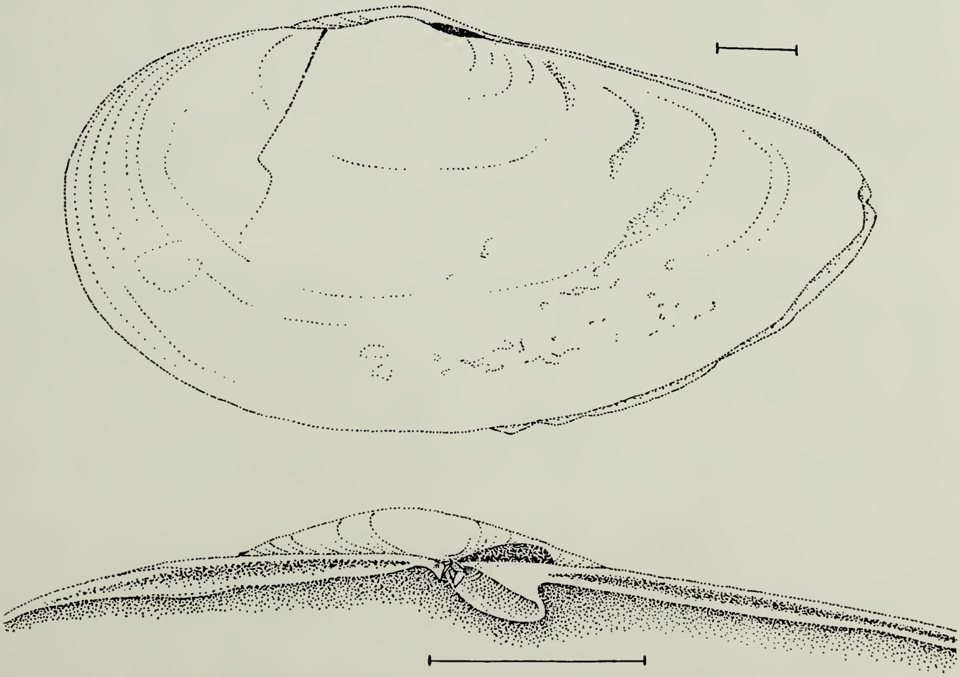

Fig. 2 *Theora fragilis* (Adams); complete shell of holotype and hinge of paratype.

both species were synonymous the holotype and paratype of *Neaera fragilis* A. Adams (1855, p. 226) were examined. *Theora fragilis,* however, lacks the chondrophore typical of *Endopleura,* is more tapered at the posterior end and more inflated than *lubrica* (Fig. 2). *Theora fragilis* is very similar to *Theora nitida,* the type of which was collected from the Philippines, and which has been dredged off Sydney, N.S.W., Australia (Australian Museum Collection). Future more detailed comparison may show that *fragilis* and *nitida* are synonyms.

DISCUSSION

Considering the volume of ocean traffic in the twentieth century it is not surprising that such fouling molluscs as mussels and oysters have become widely dispersed. For example, Dinamani (1971a; 1971b) has recorded the Japanese Oyster, *Crassostrea gigas* Thunberg, from northern New Zealand. One cannot, however, as easily explain the transportation of *Theora,* a genus adapted to life in muddy, often anaerobic, sediments, and most unlikely to adhere to ship hulls. Powell (1974) maintained that the Auckland Harbour records might have been the result of dissemenules introduced on prefabricated sections of the harbour bridge, towed from Japan. This would, however, be an unlikely source of specimens for the Bay of Islands, Whangaroa Harbour and Marlborough Sounds records. It is difficult to imagine how the spat or juveniles of *Theora lubrica* could have been carried in such a way. It is not necessary, now, to try and derive the New Zealand populations of *Theora lubrica* from Japan using man as a dispersal agent. It is simpler to suggest a natural invasion from southeast Australia.

Under favourable conditions of ocean current, wind patterns, temperature, spat longevity and distribution, species of mollusc usually associated with more tropical parts of the Pacific sometimes become temporarily established in New Zealand. *Limaria orientalis* (Adams & Reeve, 1850) has become established several times in New Zealand since the Miocene, the latest recorded invasion occurring in 1972 (Powell, 1974, p.203). This type of haphazard colonization is to be expected occasionally when the spat reservoirs are in Australia. Although the type of *Limaria orientalis* is from the Philippines, the species occurs in New South Wales, Victoria and South Australia, and Japan in the north of its range.

The closely matching distributions of *L. orientalis* and *T. lubrica,* their different habitats not withstanding, and their recent coincidental colonization of New Zealand strongly suggests similar spat longevity and ecological tolerance. Some environmental parameter/s has/have changed sufficiently in the period 1970-72 to allow spat of two species, until recently known only on the western side of the Tasman Sea, to become established in New Zealand. *Theora* is apparently more temperature-tolerant than *Limaria* and has been recorded as far south as Marlborough Sounds, whereas the limid is known only from northern parts of the North Island.

Over the past eight years, many additional species new to the New Zealand fauna, but known in Australia or the Indo-Pacific, have been recorded. Some of these are listed below, with the date of the first live-taken specimen in New Zealand indicated: *Myochama tasmanica* (1973); *Morula (Neothais) chaidea* (1972); *Tonna perdix* (1972); *Lyncina vitellus* (1967); *Bursa bubo lissostoma* (1967); *Fusinus genticus* (1972-73); *Terebra circumcincta* (1971); *Balcis (Pictobalcis) articulata* (1970-71); *Hinea brasiliana* (1925; 1968). One live specimen of *Hinea brasiliana* was found in Whangaroa Harbour in 1925 but, apparently, the species became extinct in New Zealand until a successful spat invasion, probably in the late 1960's.

The southern limits of many species of mollusc are being extended sufficiently to allow colonization of northern New Zealand. This is probably caused by both a small increase in water temperature, enabling spat survival in higher latitudes and some change in surface water currents. Meteorological records for air temperature at Auckland show a progressive warming over the last thirty years (pers. comm. Dr L. Paul, Wellington), indirect evidence suggesting that water temperatures could be increasing in northern New Zealand. In the latter case, spat which would have been carried to the north and east of New Zealand have been reaching the Northland coast over the last eight years (and, sporadically, before that). Both phenomena may be acting together to produce the latest wave of successful invasions, though I can find no documentary evidence to support the change in ocean current idea. That there have been other invasions is shown by the fossil record (e.g. *Limaria orientalis*), early records (e.g. *Hinea brasiliana)* and the recently derived Australian component of the New Zealand fauna (e.gs. *Thais orbita; Philippia lutea; Bullinula lineata*).

Seapy (1947) provided a summary of occurrences of *Theora lubrica* in southern California where it has been reported since 1970 in Los Angeles Harbour, Long Beach Harbour, Alamites Bay, Sunset Bay and Newport Bay. He considered that the species was introduced by U.S. Navy ships previously stationed in Indo-China; but just how the ships did this was not indicated. Spat surviving in bilge water (?) would seem the only possible explanation, if indeed the specimens were transported by man across the north Pacific and were not natural invasions. *T. lubrica* was first recorded from North America in California by Coan (1973, p.325). The extension of the range of lubrica from Indonesia, Thailand, China, Philippines, Japan and Australia, in the north to America and in the south to New Zealand occurred over the same period 1970-71. It is difficult to determine whether this correlation is anything more than coincidence.

ACKNOWLEDGEMENTS

I am grateful to Miss A. Blake and Ms S. Whybrow (British Museum, Natural History) for sending me the holotype and a paratype of *Neaera fragilis* Adams, and Dr W.F. Ponder for providing access to the mollusc collection of the Australian Museum.

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TERTIARY FOSSIL LOCALITIES AT WAIHEKE ISLAND, AUCKLAND

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According to a recent news item in the local press, from Mr. C. Morley of the Auckland Technical Institute, an important bed of Miocene fossil shells was temporarily laid bare at the western end of Oneroa Beach, Waiheke Island. Torrential rains in early January of this year washed off the sand from that end of the beach and revealed about a hundred square feet of the underlying richly fossiliferous mudstone.

Two other extensive fossiliferous beds on Waiheke Island were made known in 1928 and 1938 respectively by the present writer, the earlier occurrence in a paper in collaboration with the late Professor J. A. Bartrum. The 1938 paper supplied a combined checklist for the two main localities but only one species was then known from the third locality which is the one reported by Mr. Morley.

Following is a description of the location of the three known fossiliferous beds on Waiheke, referred to in the checklist as A.B.andC.

A. The original bed, discovered by Mr.E.W.Tetley in 1927, and reported upon by Powell and Bartrum in 1929. It is situated in a small bay half a mile north-west of Oneroa Beach and the fossils occur both in the lower part of the cliff and also in the tidal platform.

B. The locality in the tidal platform at the western end of Oneroa Beach, and apparently it is very seldom free from an overlay of sand.

C. The Squadron (or "Church") Bay locality reported upon in the writer's 1938 paper. It is situated on the western coast of the Island, about one mile to the south-west from Oneroa Beach, and is almost a replica of the original locality, the shore platform bting particularly rich in well preserved fossils.

All three beds were apparently deposited at about the same time and represent accumulations in small sheltered hollows worn into the Trias-Jura greywacke terrain prior to Tertiary submergence.

The age of the beds is considered to be the Otaian Stage of the Pareora System of the Lower Miocene; approximately 20 to 25 million years old.

The checklist of fossil molluscs recorded so far from the Waiheke beds, which follows, has been brought up to date to conform with modern nomenclatural requirements, and the paper concludes with remarks on some of the species of special interest.

The writer would appreciate the opportunity of examining any further collections of fossils that may be made from the Oneroa beds, especially from the elusive site B, should it again be found free of sand.

The Waiheke Miocene fossil locality of Powell & Bartrum 1929, situated half a mile north-west of Oneroa Beach. A.W.B.Powell photo.

The Waiheke Miocene fossil locality of Powell 1938, situated near to Squadrom (or Church) Bay, about one mile to the south-east from Oneroa Beach. A.W.B.Powell.

GASTROPODA

Haliotis (Notohaliotis) cf.waitemataensis Powell,1938. A.
Tugali navicula Finlay, 1927. A.
Cellana thomsoni Powell & Bartrum,1929. A.
Modelia aff.granosa (Martyn,1784). A.
Sarmaturbo superbus (Zittel,1864). A.C.
Bembicium priscum Powell & Bartrum,1929. A.
Estea impressa (Hutton,1885) = E.verticostata P.&B.,1929. A.
Powellisetia sp. A.
Subonoba sp. A.
Nozeba candida Finlay, 1924. A.
Zeacolpus tetleyi Powell & Bartrum,1929. A.
Maoricolpus gittosina Powell & Bartrum, 1929. A.C.
Maoricolpus waitemataensis Powell & Bartrum,1929. A.C.
Pyrazus consobrinus Powell & Bartrum,1929. A.C.
Pyrazus waitemataensis Powell & Bartrum,1929. A.C.
Zefallacca benesulcata Powell & Bartrum,1929. A.C.
Sigapatella perampla Powell & Bartrum,1929. A.
Sigapatella patulosa Powell & Bartrum,1929. A.
Sigapatella subvaricosa Powell & Bartrum,1929. A.
Maoricrypta aff.costata (Sowerby,1824). A.
Maoricrypta aff.opuraensis (Bartrum & Powell,1928). A.
Struthiolaria lawsi Powell & Bartrum,1929. A.C.
Willungia fracta (Tomlin,1916). C.
Magnatica (Spelaenacca) waitemataensis Powell,1938. C.
Polinices oneroaensis Powell & Bartrum,1929. A.C.
Echinophoria oneroaensis (Powell,1938). A.
Oniscidea harpaformis (Powell & Bartrum,1929). A.
Cabestana tetleyi (Powell & Bartrum,1929). A.C.
Proxicharonia arthritica (Powell & Bartrum,1929) A.C.
Mayena bartrumi Powell,1938. C.
Muricopsis echinophorus (Powell & Bartrum,1929). A.
Vesanula waitemataensis Powell & Bartrum,1929. A.
Xymene asperula Powell & Bartrum,1929. A.
Lepsiella maxima Powell & Bartrum,1929. A.C.
Lepsiella intermedia Powell & Bartrum,1929. A.
Penion exoptatus (Powell & Bartrum,1929). A.
Buccinulum tetleyi Powell & Bartrum,1929. A.
Austrofusus (Neocola) oneroaensis Powell & Bartrum,1929. A.
Cominella (Paracominia) finlayi Powell & Bartrum,1929. A.C.
Cominella (Paracominia) lignaria Powell & Bartrum,1929. A.C.
Hima (Mirua) aff.socialis (Hutton,1886). C.
Mitra (Eumitra) waitemataensis (Powell & Bartrum,1929). A.
Baryspira (Gemaspira) platycephala Powell & Bartrum,1929. A.C.
Waihaoia sp. C.
Austrotoma finlayi Powell,1938. A.C.
Inquisitor cf.awamoaensis (Hutton,1873). A.
Tomopleura transenna (Suter,1917). A.
Rugobela sepelibilis (Powell & Bartrum,1929). A.
Acteon oneroaensis Powell & Bartrum,1929. A.
Cylichnina enucleata Powell & Bartrum,1929. A.
Linopyrga cf.pseudorugata Marshall & Murdoch,1921. A.

AMPHINEURA

Ischnochiton vetustus Powell & Bartrum,1929. A.

SCAPHOPODA

Dentalium sp. A.C.

BIVALVIA

Nucula cf. nitidula A.Adams,1856. A.
Arca waitemataensis Powell & Bartrum,1929. A.
Glycymeris (Grandaxinea) aucklandica Powell,1938. C.
Modiolarca cf. impacta (Hermann,1782). A.
Perna tetleyi (Powell & Bartrum,1929). A.
Pteria oneroaensis (Powell & Bartrum,1929). A.
Isognomon sp. C.
Isognomon cf. zealandicus (Suter,1917). B.
Anomia trigonopsis Hutton,1877. A.C.
Lima sp. A.
Crenostrea gittosina (Powell & Bartrum,1929). A.C.
Chama sp. A.
Eucrassatella ampla (Zittel,1864). A.C.
Venericardia sp. (indet.). A.
Venericardia (Megacardita) squadronensis Powell,1938. A.C.
Pteromyrtea sp. (indet.). A.
Melliteryx mirificus Powell & Bartrum,1929. A.
Maoricardium oneroaensis (Powell,1938). C.
Hedecardium greyi (Hutton,1873). A.C.
Dosinia cf. lambata (Gould,1850). A.C.
Dosinia (Raina) bensoni Marwick,1927. A.C.
Tawera cf. bartrumi Marwick,1927. A.
Eumarcia (Atamarcia) curta (Hutton,1873). A.
Scalpomactra biconvexa Powell & Bartrum,1929. A.C.
Zenatia acinaces (Quoy & Gaimard,1835). A.C.
Lutraria trapezoidalis Powell & Bartrum,1929. A.C.
Bartrumia oneroaensis (Powell & Bartrum,1929). A.
Macoma hesterna Powell & Bartrum,1929. A.
Macoma robini Finlay,1924. A.
Leptomya waitemataensis Powell & Bartrum, 1929. A.
Gari cf. lineolata (Gray,1835). A.
Caryocorbula aff. zelandica (Quoy & Gaimard,1835). A.
Notocorbula pumila (Hutton,1885). A.C.
Saxicava sp. A.
Panopea worthingtoni Hutton,1873. A.
Parapholas aucklandica Powell,1938. C.
Bankia turneri Powell & Bartrum,1929. A.

The Gastropoda are the most numerous in the species represented, and several of them indicate a contemporary climate much warmer than that of New Zealand today. They were two species of mangrove frequenting *Pyrazus,* similar to *ebeninus* of the East Australian mud-flats, and the large *Terebralia palustris* of the tropical mangrove swamps of the Indo-Pacific. Another, *Oniscidia harpaformis* is a member of a tropical and subtropical genus no longer known living in New Zealand waters, but a species of it is known from both the Kermadec Islands and deep water off the New South Wales coast.

Other noteworthy Gastropoda are the handsome *Struthiolaria lawsi,* similar to the living *papulosa* but with sharply projecting peripheral spines; *Proxicharonia arthritica,* which now has a related descendant living off the Poor Knights Islands; the large knobbly *Sarmaturbo superbus,* reminiscent of a common South African *Turbo* and *Lepsiella maxima,* which had a height of 56.5 mm., and why not, if they had to tackle the huge *Crenostrea gittosina*?

Outstanding members among the Bivalvia were the large cockle, *Hedecardium greyi,* that attained a width of 120 mm. (5 inches); the massive *Eucrassatella ampla,* almost as large; the giant oyster, *Crenostrea gittosina,* 130 mm. in width, with a maximum valve thickness of up to 80 mm., and also a fine large species of the genus *Pteria,* such as now occur in the tropical waters of the Indo-Pacific.

Of special interest was the finding of an excellently preserved wood-boring Teredo, *Bankia turneri,* even to the small and fragile pallets, that serve as a stopper to the end of the calcareous siphonal tube.

Left. *Pyrazus waitemataensis* Powell & Bartrum 1929, 73mm.

Middle. *Pyrazus consobrinus* Powell & Bartrum 1929 86.5 mm.

Right. *Terebralia palustris* (Linnaeus) for comparison. The common Mangrove swamp associate of the Indo-Pacific. 80 to 120 mm. This one is from Jaffna, Ceylon.

For the benefit of readers wishing for further information on the Tertiary fossil shell localities of the Auckland area the following abridged bibliography is provided.

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THE NATIVE LANDSNAILS OF RESOLUTION ISLAND, FIORDLAND, NEW ZEALAND

by N.W.Gardner

Abstract.

A list of species found recently on Resolution Island is given with additional notes on some species. Seventeen of these have not previously been recorded from this area. Further information on the distinctive and endemic *Paryphanta fiordlandica* Climo is also given.

The landsnail fauna of Resolution Island has never been thoroughly investigated and the published information is brief and scattered. This article records some of the results of a week's field work by J.F.Goulstone and the writer, undertaken in the southern sector of the island, in conjunction with Park Board Rangers while on one of their field trips to this part of Fiordland in February 1975.

Samples of snails were obtained mostly from under back of Rimu (either standing, or those which had fallen and had the bark lifting) and also from the underside of low ferns and other vegetation. Samples of leaf litter were bagged up and brought back for sorting under a microscope.

The following stations on Resolution Island were worked:

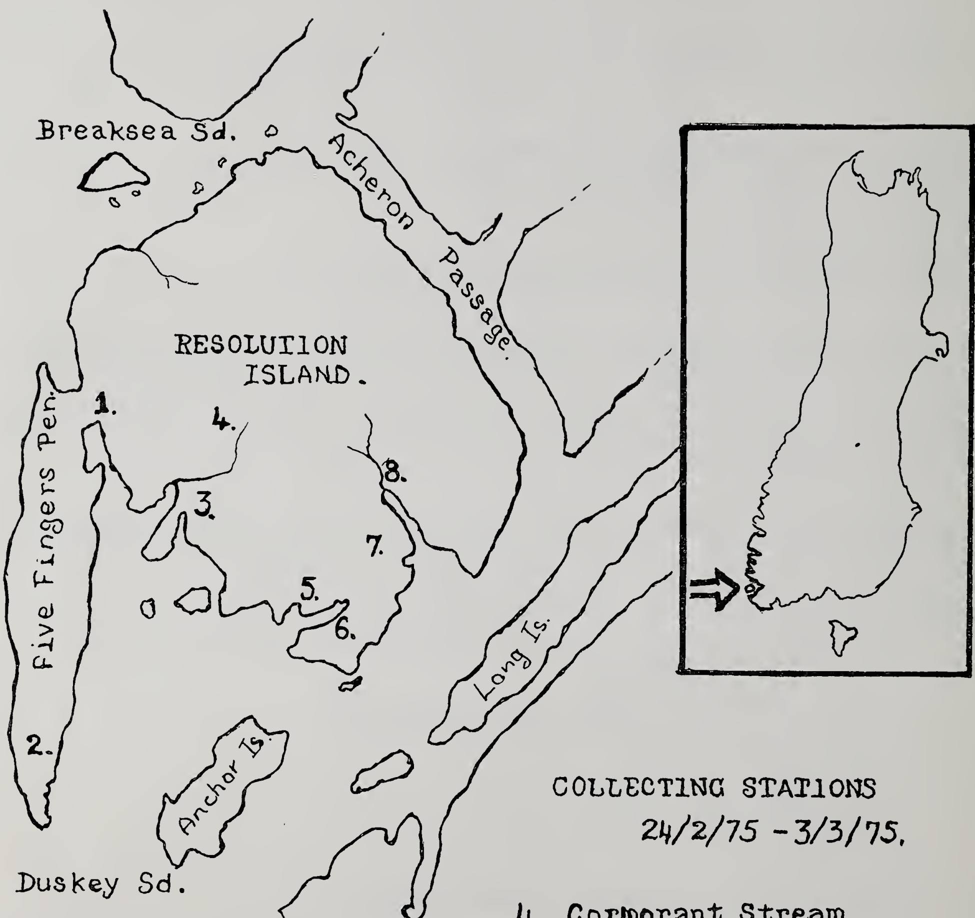
Goose Cove, South Side.
Five Fingers Peninsula.
Between Cormorant Cove and Facile Harbour.
Cormorant Stream.
Earshell Harbour.
Opposite Fixed Head.
Nook Harbour.
Duck Cove.

Previous work on the Island's terrestial mollusca:

The first field work on landsnails was that of Henry, caretaker on the island at the turn of the century. Although more interested in bird life, he did send some material to Henry Suter who named two species of *Phelussa* in 1899.

In 1949 P.C.Bull brought back some leaf litter, but the exact area from which it was obtained was apparently not recorded. Dr. R.K.Dell subsequently sorted out a further eight species from this material.

The notable find of a species of *Paryphanta* snail on Five Fingers Peninsula by A.Cragg was recorded and named by Dr. F.Climo in 1971.



1. Goose Cove.
2. Five Fingers Area.
3. Between Cormorant Cove and Facile Harbour.
4. Cormorant Stream.
5. Earshell Harbour.
6. Opposite Fixed Hd.
7. Nook Harbour.
8. Duck Harbour.

The following table records the species located on Resolution Island and the relative frequency with which they occur in the material obtained.

	Goose Cove	Nook Harb.	Off Fixed Head	Cormorant Facile Harb.	Earshell Cove	Duck Cove
Cytora chiltoni (Suter)			2		1	
Cytora pannosa (Hutton)	8	34	36	9	12	
Phelussa henryi (Suter)	4	5	1	6	2	3
Phelussa costata (Suter)		2	1	2		
Allodiscus austrodimorphus Dell						1
Allodiscus plannulatus (Hutton)	2		2	1	7	
Allodiscus n.sp.	4					
Allodiscus sp.				1		
Thermia cressida (Hutton)				4		2
Obanella allanae Dell			1			
Flammulina feredayi (Suter)			1			2
Charopa (Ptychodon) hectori (Suter)	8	126	352	38	13	235
Charopa (Ptychodon) gadus Dell	4	2	1	1	3	
Charopa (Ptychodon) smithae Dell				2		
Charopa (Ptychodon) colensoi (Suter)	2			2	1	1
Charopa (Ptychodon) reeftonensis (Suter)	18	1				
Charopa (Charopa) anguicula (Reeve)	1	1	19	1	5	8
Charopa (Charopa) bianca (Hutton)	7	2	13	42	1	34
Charopa (Charopa) pilsbryi (Suter)	1	16	15		3	3
Charopa (Subfectola) rakiura Powell		1				
Laoma (Phrixgnathus) celia Hutton	10	17	20	7	1	
Laoma (Phrixgnathus) n.sp.			3	2		
Laoma (Phrixgnathus) viridulus (Suter)	1	2	21	3		3
Laoma (Phrixgnathus) sp.		1				
Paralaoma lateumbilicata (Suter)		12	21	2	6	
Paralaoma sericata (Suter)		14	5		5	8
Pseudaneitea sp.	1					

Discussion.

Of the twentyseven species found on Resolution Island, seventeen have not previously been recorded from there. *Thermia cressida* (Hutton) and the native slug *Pseudaneitea* sp. have not been reported from the general Fiordland area.

Two species, one an *Allodiscus* and the other a Laomid are at present undescribed. The profile of the latter species is somewhat similar to *Laoma* (*Phrixgnathus*) *regularis* Suter, listed as occuring on the island, but not present in any of our samples. It may have been confused with the new species.

The landsnail fauna on the whole is not dense, no doubt because of the extreme dampness of the bush floor over most of the year. Greatest concentrations are to be found, as one would expect, in situations above ground level on tree trunks or logs. Nowhere do the larger, more significant species exist in numbers. However the very minute species *Charopa (Ptychodon) hectori* Suter (*fiordlandica* Dell) which occurs over most of New Zealand, is widespread on the island and extremely numerous as is shown on the table.

The occurance of the operculate snail *Cytora pannosa* (Hutton) on tree trunks some three metres above the ground is noteworthy. Elsewhere they have been found on vegetation, sometimes up to a height of one metre.

Cytora chiltoni Suter, which is relatively plentiful over most of the South Island is not common here. There is a marked increase in the number of axial riblets on Resolution Island specimens. Normally there are five per mm. or ten on the body whorl but this is increased to fifteen and thirtytwo respectively. In addition the ribbing is fine and even. These features indicate a regional form of this species.

The specimens of *Phelussa* obtained, allow a reasonably critical examination of the *henryi* - *costata* problem. Only a few specimens of the former have previously been available and these tend to show some overlap of conchological characters (Dell 1955). The body whorl riblet count of this larger series varies from 54 to 82, which is considerable, but in the majority of specimens there are three to four per mm. — close to Suter's description for this species. Adult shells of eight to eleven mm. have an umbilical range of 1.1 to 1.5 mm. respectively which is not significant. On the other hand *Phelussa costata* which occurs very sparsely with *henryi,* has a silky appearance, with axial riblets of seven to eight per mm. and a very small partly closed perforation. They appear to be quite distinct.

Paryphanta fiordlandica Climo. 32 mm. x 18 mm. Five Fingers Peninsula.

Opportunity was taken to visit the type locality of *Paryphanta fiordlandica* Climo on Five Fingers Peninsula. The holotype and six battered specimens were obtained by Senior Ranger A.Cragg in April 1971, from the edge of a deer track along the central ridge of the peninsula not far from the southern extremity at approximately 150 metres.

Our investigations showed that this colony is quite extensive and in a very healthy state. The main concentration of snails is well below the ridge on the eastern or 'inland' slope, where they were found to be sheltering usually under the bases of Blecknum ferns. This slope has better ground cover, and is therefore damper than the crest of the ridge and the seaward slope, the latter being completely devoid of *Paryphanta* snails. The colony extends well down the inland slope, at least as far down as we searched, about 75 metres from the ridge. There was no evidence of damage by weka and no sign of rat chewed shells. Something in excess of 200 live snails were seen.

A further very extensive colony was located by Senior Ranger Cragg in the Cormorant Stream area during these investigations. This was some little distance up the stream at the head of the Cove where numerous specimens were seen at an elevation of 15 metres and continuing to something like 450 metres. Empty shells wash down from this colony and are at times found along the shores of the cove.

Acknowledgments.

Without the generous assistance of the Fiordland Park Board, Senior Ranger A.Cragg and Area Ranger J.Ward this survey of native land snails could scarcely have been possible and certainly not so extensive.

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PECTEN (CHLAMYS) SUTERI HERTLEIN, 1933, A NEGLECTED *NOM. NOV.* FOR *PECTEN RADIATUS* HUTTON (PREOCCUPIED)

by

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The late Leo G. Hertlein of the California Academy of Sciences is known to New Zealand conchologists as the author of *Chlamys zeelandona* (1931) but it has hitherto escaped the notice of local compilers of checklists of living and fossil bivalves that he also renamed *Pecten radiatus* Hutton, *Chlamys gemmulata radiata* (Hutton, 1873) of recent lists, on grounds of preoccupation by Gmelin and Bosc (Hertlein, 1933).

Sherborn (1902) listed *Ostrea radiata* Gmelin, 1790 (in Linnaeus' Syst. Nat., ed. 13, I:3320) which was based on a *Pecten* (s. lat.) figured by Gualtieri (1742), later transferred to *Pecten* as a synonym of Pecten opercularis (Linnaeus), i.e. *Chlamys opercularis* (Linn.). There may be some who consider secondary homonyms should be revived when the two species are placed in different genera, but there can be no argument about *Pecten radiatus* Bosc, 1801, cited by Sherborn (1930:5414) with the reference s. a Deterville ed. Buffon, Moll. II. 1801, 264. This refers to one of the many editions of Buffon's *Histoire Naturelle,* but no work precisely agreeing with Sherborn's reference is listed in his Bibliographies. The work is unlikely to be readily available for checking but Sherborn's citations are usually accurate.

The name for *Pecten radiatus* Hutton, the Foveaux Strait-Stewart Island race of *Chlamys gemmulata,* will therefore be *Chlamys gemmulata suteri* (Hertlein, 1933).

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